Applied Soil Ecology 114 (2017) 152–160

Contents lists available at ScienceDirect

Applied Soil Ecology

journal homepage: www.elsevier.com/locate/apsoil

Labile carbon and nitrogen additions affect soil organic matter decomposition more strongly than temperature

Qianru Li[a,b], Yuqiang Tian[c], Xinyu Zhang[a,*], Xingliang Xu[a,*], Huimin Wang[a,b,f], Yakov Kuzyakov[a,d,e]

[a] Key Laboratory of Ecosystem Network Observation and Modeling, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, 11A Datun Road, Chaoyang District, Beijing 100101, China
[b] College of Resources and Environment, University of Chinese Academy of Sciences, Beijing 100190, China
[c] State Key Laboratory of Earth Surface Processes and Resource Ecology, Beijing Normal University,Haidian District, Beijing 100875, China
[d] Department of Soil Science of Temperate Ecosystems, and Department of Agricultural Soil Science, University of Göttingen, Göttingen 37077, Germany
[e] Institute of Environmental Sciences, Kazan Federal University, Kazan 420008, Russia
[f] Jiangxi Key Laboratory of Ecosystem Processes and Information, Ji'an 343725, China

ARTICLE INFO

Article history:
Received 7 January 2017
Accepted 16 January 2017
Available online 2 March 2017

Keywords:
Subtropical forest soil
Priming effects
Carbon availability
Nitrogen mining
Temperature sensitivity

ABSTRACT

Inputs of labile carbon (C) and nitrogen (N) affect the intensity and direction of priming effects (i.e., increase or decrease of soil organic matter (SOM) decomposition caused by labile inputs). Increased temperature is also an important factor affecting SOM decomposition. However, the effects of temperature on priming of SOM decomposition remain unclear. To investigate how temperature affects priming of SOM decomposition through changing microbial composition, we added ^{13}C-labeled glucose with or without NO_3^- or NH_4^+ to a subtropical plantation soil in southern China and incubated the soil at 15 °C and 25 °C for 10 days. Soil microbial composition was assessed by analysis of phospholipid fatty acids (PLFAs). Glucose led to positive priming (release of additional CO_2) at both temperatures. In contrast, glucose addition with NO_3^- or NH_4^+ resulted in negative priming. Temperature did not show a significant effect on SOM decomposition, while the effects of temperature on priming of SOM decomposition were dependent on labile C and N. Labile C addition induced stronger priming at 25 °C than at 15 °C, while combined C and N addition more strongly reduced priming at the high than the low temperature. Although PLFA composition was affected by temperature and labile C and N inputs, changes in PLFA composition were not correlated with priming. We conclude that temperature changes may have limited effects on SOM decomposition in this subtropical soil, while the availability of labile organics has a much stronger effect on priming under warming.

1. Introduction

Soil organic matter (SOM) contains the largest amount of carbon (C) in terrestrial ecosystems (German et al., 2011), almost four times higher than that in the atmosphere (Tarnocai et al., 2009). Even small changes in this soil C pool could significantly affect atmospheric CO_2 concentration, leading to positive feedbacks on climate change (Raich and Potter, 1995; Schlesinger and Lichter, 2001). Therefore, investigating the factors affecting SOM dynamics is a prerequisite for better understanding climate-carbon cycle feedbacks (Sun et al., 2014).

Temperature is an important factor affecting SOM dynamics. Increased temperature substantially accelerates SOM decomposition (Kirschbaum, 2006; Conant et al., 2011; Razavi et al., 2015), thus potentially contributing to global warming. Therefore, many studies have examined temperature sensitivity of SOM decomposition in the alpine, boreal, and temperate ecosystems (Lu et al., 2013), where the most dramatic increases in temperature have been predicted. Although greater understanding has been achieved, the results from various studies regarding the temperature sensitivity of SOM decomposition remain controversial (Giardina and Ryan, 2000; Fang et al., 2005; Bradford, 2013). Although a temperature increase is also expected in subtropical forests (Liski et al., 2003; Tan et al., 2012; Dai et al., 2016), few studies have explored the effects of warming on SOM decomposition (Wu et al., 2016).

* Corresponding authors.
E-mail addresses: zhangxy@igsnrr.ac.cn (X. Zhang), xuxingl@hotmail.com (X. Xu).

http://dx.doi.org/10.1016/j.apsoil.2017.01.009
0929-1393/